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The role of the star formation on the nitrogen abundance evolution

M. Mollá,[1], J. M. Vílchez,[2] A.I. Díaz,[3] and M. Gavilán.[3]

Abstract. We analyze the evolution of nitrogen resulting from a set of spiral and irregular galaxy models computed for a large number of input mass radial distributions and with various star formation efficiencies. We show that our models produce a nitrogen abundance evolution in good agreement with the observational data. Differences in the star formation histories of the regions and galaxies modeled are essential to reproduce the observational data in the N/O-O/H plane and the corresponding dispersion.

1. The primary Nitrogen

When observations, specially the metal-poor galaxy data, are ploted in the plane N/O *vs* O/H, it is evident that a primary N contribution must exist. Applying the classical *Closed Box Model*, the points may be limited by three lines as those plotted in Fig. 1a: 1) This one called NS, which shows the evolutionary tracks of N/O when N need a seed of O to be created: $\frac{N}{O} = \frac{p_N(O)}{p_O} \propto O$. 2) This one called NP that appear when N is created directly from H or He: $\frac{N}{O} = \frac{p_N}{p_O} = constant$. 3) NS+NP when both contributions there exist, which seems to be the apparent behavior reproduced by the data.

It is, however, necessary to take into account three factors not included in that simple scenario: 1) the mean lifetimes of stars, 2) the star formation efficiency or the existence of different star formation histories or star formation rates in different galaxies or objects, and 3) the metallicity dependent of stellar yields. If the NP is ejected by low and intermediate mass (LIM) stars, it will appear in the interstellar medium very abruptely after a time delay, which means when O/H has already reached a certain value. Obviously, this level will be higher or lower depending on the mean-lifetime of these stars. But it also depends on the efficiency to form stars: for a high efficiency the NP will appear later in the time, or at higher O/H, than for a low one. Both facts produce a certain dispersion in the resulting abundances. Besides that the metallicity dependent stellar yields produce tracks elongated in comparison with the one produced when only a value of yield is used (for details see Mollá et al. 2006).

[1]CIEMAT,Departamento de Investigación Básica, Avda. Complutense-22, 28040 Madrid, (Spain)

[2]Instituto de Astrofísica de Andalucía, CSIC, Apdo. 3004, 18080 Granada, (Spain)

[3]Departamento de Física Teórica, Universidad Autónoma de Madrid, 28049 Cantoblanco, Madrid (Spain)

2. The multiphase chemical evolution models grid.

We have computed a grid of models (Mollá & Díaz 2005) with 44 theoretical galaxies of different total masses and 10 possible efficiences to form stars in each one. We have used the yields from Woosley & Weaver (1995) for massive stars and those from Gavilán, Buell & Mollá (2005) for LIM stars, which give results for our Galaxy (Gavilán, Mollá & Buell 2006) in excelent agrement with halo stars data (Israelian et al. 2004; Spite et al. 2005).

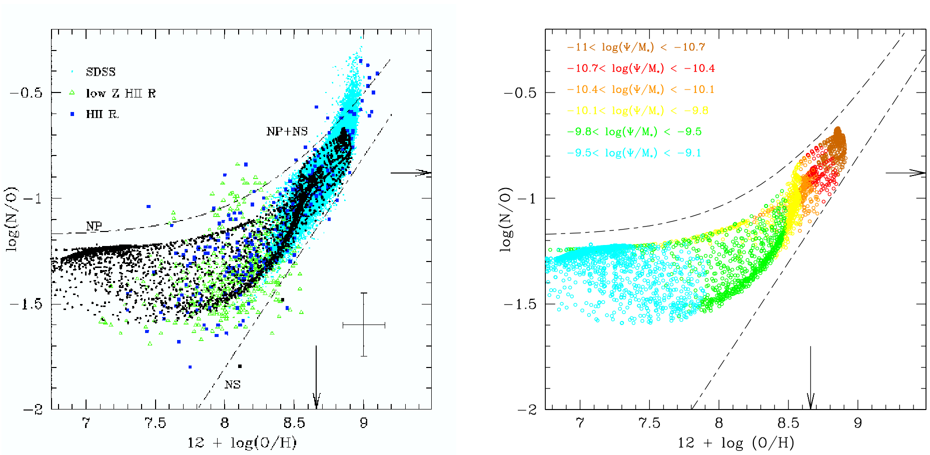

Figure 1. The relative abundance $log(N/O)$ *vs* the oxygen abundance $12 + log(O/H)$: a) Our model results for the present time as small black dots compared with data (colors as labelled) from authors given in Table 1 of Mollá et al. (2006); b) The same results are represented according their present specific star formation rate as labelled.

The obtained results (Mollá et al. 2006) for the present time are compared with observations in Fig. 1a). The position of a galaxy in the plane N/O-O/H depend on the star formation histories and/or on the actual star formation rate as we may see in Fig. 1b): if the star formation occured as a strong and early burst, with a low rate at the present time compared with the past maximum (red dots), the evolutionary track in that plane appears as very secondary and O/H and N/O are high. When the star formation occurs quietly with a rate higher now than in the past (cyan dots), the track is almost flat with low O/H and N/O abundances. This way we conclude that our grid of models reproduce and explain very well most of observational data in the plane N/O-O/H.

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